

## CLAIMS

### What is claimed is:

1           1.     An apparatus for reducing the parachuting of a probe measuring the  
2 topography of a surface comprising:  
3           an oscillating probe; *detector module (210) - 100*  
4           a phase detection circuit coupled to the oscillating probe; and  
5           a probe drive boosting circuit coupled to the phase detection circuit and the probe,  
6 wherein the phase detection circuit detects a reduction of a variation of a phase  
7           signal from the probe and the probe drive boosting circuit boosts a signal to  
8           the probe based on the phase signal detected by the phase detection circuit to  
9           produce a boosted probe drive signal.

1           2.     The apparatus according to claim 1, wherein the phase detection circuit  
2 comprises:  
3           a precision full wave rectifier; and  
4           an envelope detector coupled to the precision full wave rectifier,  
5 wherein the precision full wave rectifier rectifies a phase signal of the probe to  
6           produce a rectified phase signal and the envelope detector detects the  
7           rectified phase signal to produce an envelope detected signal.

1           3.     The apparatus according to claim 2, wherein the phase detection circuit  
2 further comprises:  
3           a comparator coupled to the envelope detector; and  
4           an event detector and hold off circuit coupled to the comparator,  
5 wherein the comparator and the event detector and hold off circuit generate an event  
6           signal from the envelope detected signal.

1           4.     The apparatus according to claim 3, wherein the phase detection circuit  
2 further comprises a multiplier coupled to the event detector,  
3 wherein the multiplier combines the event signal with a probe drive signal to  
4           produce the boosted probe drive signal.

1           5.     The apparatus according to claim 3, wherein the phase detection circuit  
2 further comprises:  
3           a multiplier coupled to the event detector; and  
4           a control module, wherein the multiplier combines the event signal with a gain  
5           setting in the control module to increase error integration.

1           6.     The apparatus according to claim 4, further comprising an event level setting  
2 circuit coupled between the event detector and hold off circuit and the multiplier, wherein  
3 the event level setting circuit sets an event level of the event signal.

1           7.     The apparatus according to claim 4, wherein the boosted probe drive signal  
2 is boosted 20 to 30 percent of the probe drive signal above the probe drive signal.

1           8.     The apparatus according to claim 3, wherein the event detector and hold off  
2 circuit delays the generation of the event signal for a predetermined time.

1           9.     A method for reducing the parachuting of a probe obtaining accurate  
2 information representative of a surface of a sample comprising:

3           scanning the surface of the sample with an oscillating probe;  
4           detecting a reduction of a variation of a phase signal of the probe indicative of free  
5           oscillation of the probe; and  
6           reducing a distance between the probe and the sample in response to the detection of  
7           the reduction of the variation of the phase signal of the probe.

1           10.    The method according to claim 9, wherein the detecting step further  
2 comprises:  
3           rectifying the phase signal of the probe to produce a rectified phase signal; and  
4           envelope detecting the rectified phase signal of the probe to produce an envelope  
5           detected phase signal of the probe.

1           11.     The method according to claim 9, wherein the reducing step further  
2 comprises boosting a drive signal of the probe to produce a boosted drive signal of the  
3 probe.

4           12.     The method according to claim 11, wherein the detecting step further  
5 comprises triggering an event signal based on the detected phase signal and the boosting  
6 step further comprises boosting the drive signal of the probe by combining the event signal  
7 with the drive signal of the probe to produce a boosted drive amplitude signal.

1           13.     The method according to claim 12, wherein the detecting step further  
2 comprises delaying the triggering of the event signal for a predetermined time.

1           14.     The method according to claim 11, wherein the boosted drive signal is 20 to  
2 30 percent of the drive signal above than the drive signal.

1           15.     The method according to claim 9, further comprising:  
2 detecting an error signal of the probe when the oscillating amplitude of the probe is  
3 too high; and  
4 accumulating the error signal of the probe.

1           16.    The method according to claim 9, further comprising:  
2           detecting an error signal of the probe when the oscillating amplitude of the probe is  
3           too small; and  
4           accumulating the error signal of the probe.

1           17.    The method according to claim 9, wherein the detecting step detects a  
2           reduction of a variation of a phase signal when the phase difference between a sinusoidal  
3           drive and a probe response signal is substantially 90 degrees.

1           18.    The method according the claim 9, wherein the reducing step further  
2           comprises boosting a drive signal of the probe to increase the accumulation of an error  
3           signal of the probe.

1           19.    An apparatus for reducing the parachuting of a probe measuring the  
2           topography of a surface comprising:  
3           an oscillating probe;  
4           parachuting detection circuitry coupled to the oscillating probe  
5           parachuting reduction circuitry coupled to the parachuting detection circuitry,  
6           wherein the parachuting reduction circuitry reduces the parachuting of the  
7           probe in response to the detection of parachuting of the probe.

1           20.    The apparatus according to claim 19, wherein the parachuting detection  
2    circuitry comprises a phase detection circuit and the parachuting reduction circuitry  
3    comprises a probe drive boosting circuit.